Public Health Pesticide Applicator Training Manual

THE SAFE USE OF PESTICIDES

The correct use of pesticides is critical: too much of a chemical may damage or kill non-target organisms; too little may not provide adequate control or contribute to resistance in pest species. Many desirable animals, fish, insects, and birds can be harmed by the incorrect or careless use of pesticides. And, of course, people can be harmed by the careless use of, or accidental exposure, to pesticides. Pesticides are an important tool, but we must use them wisely, properly, and safely.

The widespread use of synthetic chemicals to help produce food and fiber, to protect our health, and to preserve the structures we live in, has also created a demand for stricter control of these materials. As a result, laws and regulations have been enacted to protect the general public, the applicator, and the environment from the negative side effects of pesticides. The Federal Food Quality Protection Act (FQPA), an amendment to the Federal Insecticide Fungicide and Rodenticide Act (FIFRA), dictates how pesticides will be managed. Each state must comply by meeting or exceeding the minimum federal standards. In addition, every state has its own set of rules and regulations to which pesticide applicators must conform; all these rules are available from your state Pesticide Coordinator.

Compliance to FIFRA and FQPA is controlled by the federal Environmental Protection Agency (EPA). Each pesticide must be used in strict accordance with the EPA-regulated instructions on the product label. Any deviation from the label constitutes a misuse and subjects the user to either civil or criminal penalties. The pesticide label is a legal document according to federal and state laws.

The Federal Food, Drug, and Cosmetic Act, which is also administered by the EPA, requires that maximum permissible residue levels be established for each pesticide on each edible crop. Public health pesticides sometimes are used in crop lands, e.g., for control of mosquitoes in flooded rice lands where they can be effective larvicides.

I. TOXICOLOGY

Toxicology is the science of poisons. In the 16th century Paracelsus wrote: "All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy." Paracelsus was right. All substances can be poisonous under certain circumstances. Gasoline that you put into your car becomes a poison if you drink it, salt becomes a poison if taken in excessive quantities, and even water becomes a poison if you try to breathe it. It has been said: "There are no harmless substances. There are only harmless ways of using substances." This is a true and very important concept.

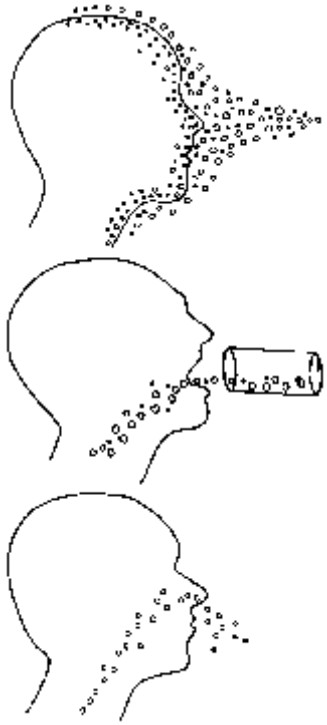
How Poisons Work

Poisons work by altering normal body functions. Thus, toxicity can occur in as many ways as there are body functions. Many poisons work by changing the speed of different body functions, speeding them up (for example, increasing heart rate or perspiration), or slowing them down (sometimes to the point of stopping them entirely). Toxic effects are thus imbalances of body function which produce the symptoms of illness characteristic of each poison.

For example, people poisoned by an organophosphate insecticide experience increased sweating. The process of the poisoning with respect to sweating is as follows: the first step is the biochemical inactivation of an enzyme. This biochemical change leads to a cellular change (in this case an increase in nerve activity). The cellular change is then responsible for physiological changes, which are the symptoms of poisoning seen or felt in particular organ systems (in this case the sweat glands). The basic progression of effects from biochemical to cellular to physiological occurs in all cases of poisoning.

Types of Toxicity

Toxicity is a general term used to indicate adverse effects produced by poisons. These adverse effects can range from slight symptoms like headaches or nausea, to severe symptoms like coma and convulsions. Death (lethality) is the most severe toxic effect. Poisons can affect just one particular organ system or they may produce generalized toxicity by affecting a number of systems. For example, chemicals that affect our nose, trachea or lungs are referred to as respiratory poisons, or renal poisons if they affect kidney function.



Toxicity types are based on the number of exposures to a poison and the time it takes for toxic symptoms to develop. Most toxic effects are **reversible** and do not cause permanent damage, but complete recovery may take a long time. However, some poisons cause **irreversible** (permanent) damage. **Delayed toxicity** may occur many years after exposure to a chemical and is most often only discovered in retrospective epidemiological studies (studies done later, or after the fact). An industrial example of delayed toxicity is asbestos. Epidemiological studies are crucial to the detection of further occurrences of delayed toxicity.

An **acute exposure** is when a reaction occurs following a single exposure to a pesticide. Acute dermal refers to a single dose applied to the skin; acute oral refers to a single dose taken by mouth; and acute inhalation refers to a single dose that is inhaled. A **chronic exposure** is the result of repeated or continuous exposures and can be described in terms of chronic dermal, chronic oral, or chronic inhalation toxicity. **Subchronic exposure** occurs when there has been repeated or continuous exposure to a pesticide, but no measurable toxic affects have resulted.

Toxicity Testing and Measurement

The effects of exposure to poisons vary with the dose or amount of exposure. Usually when we think of dose, we think in terms of taking one vitamin capsule a day or two aspirin every four hours. Contamination of food or water with chemicals can provide doses of the chemicals each time we eat or drink. The commonly used measures for expressing doses of poisons tell us how much of the chemical is in food, water, or air. The amount we eat, drink, or breathe determines the actual dose received. Concentrations of chemicals in the environment are most commonly expressed in parts per million or billion, **ppm** and **ppb**, respectively. These are extremely small quantities.

Toxicity of Pesticides

Since pesticide toxicity varies widely, it is very important for persons who use pesticides or those who regularly come in contact with pesticides to have at least a general knowledge of the relative toxicity of the products that are being used. The toxicity of a particular pesticide is determined by subjecting test animals (usually rats, mice, rabbits, and dogs) to different dosages of the active ingredient in a pesticide product. The active ingredient is that portion of a pesticide formulation that is toxic to the pest. The toxicity of each active ingredient is determined by at least three methods: (1) oral toxicity by feeding the chemical to test animals; (2) dermal toxicity by exposing the skin to the chemical and measuring its absorption through the skin into the bloodstream; and (3) inhalation toxicity by permitting the test animals to breathe vapors of the chemical. In addition, the effect of the chemical as an irritant to the eyes and skin is examined under laboratory conditions.

Toxicity is usually expressed as **LD_{50}** (lethal dose 50) and **LC_{50}** (lethal concentration 50). This is the amount of the active ingredient of a toxicant required to kill 50 percent of a test population of animals under a standard set of conditions. Toxicity values of pesticides, based on an acute (single dosage) exposure, are recorded (for dose) in milligrams of pesticide per kilogram of body weight of the test animal (mg/kg) or (for concentration) in parts per million (ppm). LD_{50} and LC_{50} values are useful in comparing the toxicity of different active ingredients as well as different formulations of the same active ingredient. The lower the LD_{50} or LC_{50} of a pesticide product, the greater the toxicity of the material to people and animals - because it takes less of the toxicant to kill than with pesticides with a high LD_{50}, which is the least toxic when used according to directions on the product labels. Pesticide products are categorized on the basis of their LD_{50} or LC_{50} values. (See Table 10-1)

Toxic Category I pesticides are classified as highly toxic on the basis of either oral, dermal, or inhalation toxicity; they must have the signal words **DANGER** and **POISON** (in red letters) and a skull and crossbones prominently displayed on the package label. The Spanish equivalent for danger, **PELIGRO**, must also appear on the labels of highly toxic chemicals. As little as a few drops of such a material taken orally could be fatal to a 150 lb person. In this group, the acute (single dosage) oral LD_{50} ranges from a trace to 50 mg/kg; inhalation LC_{50} up to and including 0.2 mg/liter; dermal LD_{50} up to and including 200 mg/kg; eye effects - corrosive, corneal opacity not reversible within 7 days; skin effects - corrosive.

Toxic Category II pesticides are products considered moderately toxic; these must have the signal word **WARNING** (**AVISO** in Spanish) displayed on the product label. Acute oral LD_{50} ranges from 50 to 500 mg/kg (from 1 teaspoon to 1 ounce of this material could be fatal to a 150 lb person); inhalation LC_{50} from 0.2 through 2 mg/liter; dermal LD_{50} from 200 through 2,000 mg/kg; eye effects - corneal opacity reversible within 7 days; skin effects - severe irritation at 72 hours.

Toxic Category III pesticide products classified as either slightly toxic or relatively nontoxic are required to have the signal word **CAUTION** on the pesticide label. Acute oral LD_{50} values from 500 mg/kg through 5,000 mg/kg; inhalation LC_{50} from 2 through 20 mg/liter; dermal LD_{50} from 2,000 through 20,000 mg/kg; eye effects - no corneal opacity, irritation reversible within 7 days; skin effects - moderate irritation at 72 hours.

Toxic Category IV pesticide products shall bear on the front panel the signal word "CAUTION" on the pesticide label. Acute oral LD_{50} values greater than 5,000 mg/kg; inhalation LC_{50} greater than 20 mg/liter; dermal LD_{50} greater than 20,000 mg/kg; eye effects - no irritation; skin effects - mild or slight irritation at 72 hours.

Pesticides formulated in petroleum solvents or other combustible liquids must also include the precautionary word **FLAMMABLE** on the product label.

Despite the fact that some pesticide products are considered to be only slightly toxic or relatively nontoxic, all pesticides can be hazardous to man, nontarget animals, and the environment if used in a manner that is inconsistent with the instructions on the product label. Use the pesticide only as recommended by the manufacturer. As the applicator, you are legally responsible if a pesticide is misused in any way.

II. PUBLIC HEALTH PESTS AND PESTICIDES

Public health pests are living organisms that cause damage to livestock and annoy or transmit diseases to people or animals. These pests can be animals such as insects, spiders, ticks, mites, rats, birds or snails. Microorganisms such as bacteria and viruses can be pests as well. Pesticides are substances or mixtures of substances intended for controlling, preventing, destroying, repelling or mitigating any form of life declared to be a pest or for use as an insect or plant growth regulator. Insecticides, herbicides, acaricides, defoliants, desiccants, fungicides, nematicides and rodenticides are some of the many kinds of pesticides. Only a few materials are registered solely for public health applications.

Manufacturers of pesticides spend considerable time and money developing and testing new products before releasing them. The industry commonly tests thousands of different compounds before finding a material that will become a marketable product. Costs of developing a single new pesticide average over $50 million and development time often exceeds ten years. Public health applications require such a small volume of pesticides that many

currently available products might not be submitted for re-registration for public health usages when their current registrations expire because of the high cost of registration. Thus, it is extremely important to use wisely the few that are available, so as not to jeopardize their public acceptability.

Some pesticides, such as fumigants (gases), are nonspecific and control a wide variety of pests indiscriminately (fungi, insects, weeds, nematodes, etc). Others target a pest at a certain stage of its development. Ovicides, larvicides and adulticides, for example, are used to control the eggs, immatures or adult stages, respectively, of insects and related arthropods. Or they may be characterized according to their target pest or control function, as follows:

acaricide - vs. ticks, mites
attractant - attracts arthropods or vertebrates
avicide - vs. pest birds
desiccant - removes water from arthropods
growth regulator - affects insect development
insecticide - vs. insects and related arthropods
molluscicide - vs. snails
predacide - vs. vertebrate pests
repellent - repels insects or vertebrates
rodenticide - vs. rodents

Alternatively, pesticides may be categorized according to the way they enter or affect the pest:

- **Stomach toxicants** enter the pest during feeding by way of the mouth and digestive tract, where they are absorbed into the pest's body.
- **Contact toxicants** generally enter the pest as a result of direct contact with treated surfaces by absorption through the pest skin or cuticle.
- **Fumigants** are volatile and enter the pest in a gaseous phase through the respiratory system.
- **Systemic toxicants** are acquired from the tissue of the pest's host, which has previously absorbed the toxicant.
- **Suffocation action** results from materials, usually oils or monomolecular surface films, which clog the breathing mechanism of the pest, such as a mosquito larva, and/or reduce the surface tension of the water so much that the pest can't remain at the surface and therefor can't get enough oxygen to survive.

Chemical Classification of Pesticides

Most common pesticides are categorized as either inorganic or organic compounds. **Inorganic** pesticides do not contain carbon; they are usually crystalline, salt-like in appearance, stable and soluble in water. This category includes arsenic, mercury and cyanide, which are ingestion type poisons, persistent in the environment and very toxic to mammals. **Organic** pesticides contain carbon, hydrogen and often oxygen, nitrogen, phosphorous or sulfur. Their appearance is variable and they are usually insoluble in water. The synthetic organics are produced by chemical synthesis and the natural organics are extracted from natural sources such as plants.

Synthetic Organics

Organophosphates (OP) contain phosphorous, act as contact poisons that penetrate the pest's epidermis, inhibit the enzyme cholinesterase and thereby affect the pest's nervous system. Examples of OPs used in public health pest control are naled, malathion and chlorpyrifos. Because they are not readily stored in fat and are usually

degraded by alkaline solutions, they do not accumulate in human tissue. However, from a human safety standpoint, because of the ease of entry and the rapidity of their effect on the central nervous system the OPs represent the greatest threat of pesticide-related acute illness to pesticide applicators. Many of these products degrade within 72 hours after application

Carbamates contain nitrogen and sulfur, act through contact, ingestion and cuticular penetration by inhibiting cholinesterase and overstimulating the insect nervous system. Members of this group do not accumulate in the environment and are rapidly inactivated under alkaline conditions. They are slightly more persistent than the organophosphates. Examples of carbamates are bendiocarb, carbaryl and propoxur. This group is second only to the OPs as a cause of human pesticide poisoning.

Synthetic pyrethroids are similar chemically to natural pyrethrins but modified to increase stability in the natural environment. Most are rapidly acting contact poisons. Examples of synthetic pyrethroids are resmethrin and permethrin. Because of their high level of activity, usually only very small quantities of active ingredient are required to control the target organisms. Adverse environmental effects can occur when even these low levels are applied in aquatic habitats because of their impact on nontarget aquatic organisms.

Insect growth regulators (IGR) include juvenile hormone mimics that affect insect development by interfering with transformation from the last larval stage into the pupal stage, and chitin synthesis inhibitors that interfere with the attachment of muscles to the outer shell (skeleton) of the insect at the time of molt. Examples of IGR's are methoprene, which is generally considered safe for use in environmentally sensitive wetlands, and dimilin, for which public health usage has been restricted to non-environmentally sensitive aquatic habitats.

Chlorinated hydrocarbons (organochlorines) once were the most familiar group of synthetic organic insecticides. In the recent past they were by far the most commonly available insecticides. Examples of chlorinated hydrocarbons are DDT, methoxychlor, and chlordane. All contain chlorine and are contact or ingestion type poisons. Their persistence in the environment and throughout the food chain (including fatty tissue in humans) caused undesirable ecological impacts and the registrations of most chlorinated hydrocarbons were suspended by the EPA. Methoxychlor was one of the few remaining chlorinated hydrocarbon registered for public health use at the turn of the century (DDT may be used in public health emergency situations under special permit).

Natural Organics

Botanicals are plant-derived compounds of various chemical structure that act as contact and/or stomach poisons. Included in this group are the pyrethrins extracted from chrysanthemums, nicotine extracted from tobacco, rotenone and strychnine. Most are not persistent in the environment.

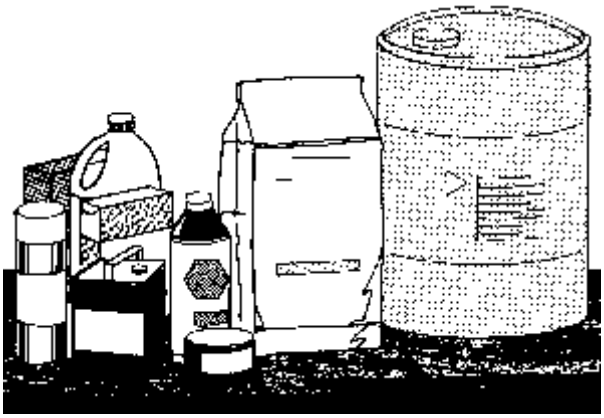
Microbial pesticides are those whose active ingredient is a bacterium, virus, fungus, or some other microorganism or product of such an organism. An example, commonly called *Bti,* is made from the bacterium *Bacillus thuringiensis* var. *israelensis* and used to control mosquito and black fly larvae. Although the product

does not contain live bacteria, the crystalline toxins within the dead bacteria act as a stomach poison. The selective activity of this larvicide against aquatic diptera make it an attractive material for use in environmentally sensitive areas. Other examples of microbials are *Bacillus sphaericus* and *Laegenidium giganteum*, a fungal parasite of mosquitoes.

Petroleum oils used as insecticides or herbicides are refined from crude oil. When formulated as insecticides they may be applied without dilution or mixed with an emulsifier and applied in water. Golden Bear Oil® is frequently used to control immature mosquitoes.

Pesticide Formulations

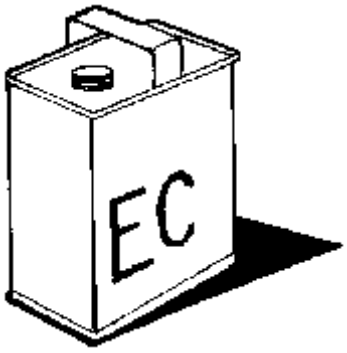
Pesticides are available in a wide variety of formulations. **Formulation** is the mixture of an active ingredient (a.i.) with some type of carrier or diluent, either a liquid or solid material, to make the chemical suitable for a type of application or equipment designed to deliver the product. Only in certain circumstances are undiluted active ingredients used to control pests. Commonly available formulations are as follows:



Aerosol (A). When packaged in a pressurized container as a liquid that contains the active ingredient in solution. This formulation is sometimes referred to as "bug bomb". These devices contain a small amount of active ingredient mixed with a propellant for release as a spray or mist. Aerosol canisters are convenient to use because they are ready to use and are easy to store. Special caution is necessary when handling aerosol canisters which, if punctured or burned, may explode into small metal fragments. Other means of producing aerosols, such as with thermal fog or ultra-low-volume (ULV) generators, are discussed in Chapter 11.

Bait (B). A poisonous bait is composed of an edible substance or some other attractant mixed with an active ingredient. The pest usually must eat the bait for the active ingredient to take effect. Baits related to public health are used to control certain ants, roaches, flies, snails and slugs, rodents and other pest mammals, and pest birds. Children, domestic animals and wildlife can be poisoned by these formulations if they are improperly placed.

Dust (D). A dust contains an active ingredient in a finely ground inert substance such as talc, clay, nut hulls, or volcanic ash and is ready to use as purchased. Dusts are often used to control fleas and other ectoparasites on pets, and in rodent burrows in plague control operations. The amount of active ingredient in insecticdal dusts usually ranges from 0.5 to 10 percent. The major advantage of dust formulations is the ease of handling with low-cost application equipment. However, dusts are relatively expensive for the amount of active ingredient in the total formulation and may be more irritating to the applicator than sprays.



Emulsifiable Concentrate (EC or E). This is a liquid formulation in which the active ingredient is dissolved in one or more petroleum-based solvents. An emulsifier is added so that the material will mix readily with water. Emulsifiable concentrate formulations usually contain between 2 and 8 lb a.i./gal and are easy to measure and mix into lower concentrates for final application. They are not abrasive and will not plug screens and nozzles. Because of the high concentration of active ingredient in EC formulations, there may be considerable hazard to the applicator and other persons if the product is accidentally spilled on the skin or consumed. They are highly flammable due to the petroleum solvent. Compatibility and phytotoxicity (toxicity to plants) of EC materials may occasionally be a problem.

Flowable (F). This formulation consists of finely ground solid particles of active ingredient formulated to stay suspended in a liquid carrier. Flowables can be mixed readily with water and usually do not clog nozzles, but they need moderate agitation to remain in suspension. Micro-encapsulated pesticides, formulated as flowables, are enclosed in microscopic beads of plastic material that release the active ingredient gradually as the plastic deteriorates.

Fumigant (LG). This is a gaseous pesticide, usually formulated as a liquid under pressure which becomes a gas only when released. Fumigant use is generally limited to soil and sealed structures. Because fumigants are non-selective in their action and can penetrate into any area that is not airtight, they are the most hazardous of all pesticide formulations. Protective equipment, including adequate respiratory protection devices, must be used at all times. Some fumigants can severely irritate or burn the skin. Often fumigants are formulated with some type of warning gas, but this gas frequently is also highly toxic. [Aerosols, smokes, mists, and fogs are finely dispersed particles and thus are not considered fumigants.]

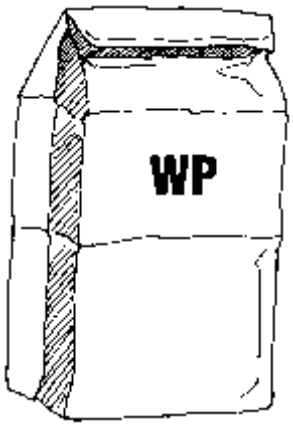
Granules, Pellets (G). These formulations are dry, ready-to-use materials normally containing from 2 to 15 percent active ingredient. Most granules are prepared by applying the active ingredient to a coarse, porous, inert material such as clay or ground corn cobs to form particles of various sizes. Their weight usually ensures that they will penetrate dry vegetation and reach the ground or water surface.

Solution (S). A solution is designed to be used without further dilution (Ready-To-Use, RTU) or to be diluted with specially refined oil or other petroleum-based solvents. Some materials in this category can be mixed with water to form true solutions. High-concentrate formulations contain 8 lb a.i./gal or more, while low concentrates usually contain less than 2 lb a.i./gal. Many are formulated with chemicals that function as spreaders and stickers.

Water Dispersible Granules (WDG). These formulations are dry, granular materials designed to disperse or break apart when mixed with water. The resulting preparation has all the characteristics of a flowable formulation or a finely dispersed wettable powder. The major advantage of a water dispersible granule is the ease of handling. The

absence of dust-like particles reduces the respiratory hazard often associated with wettable and soluble powder formulations.

Wettable Powder, Soluble Powder (WP, SP). These are dry, powdered formulations usually containing from 25 to 80 percent active ingredient. Wettable powders are mixed with water to produce suspensions, whereas soluble powders dissolve to form solutions. A wetting agent is often added to keep suspended particles uniformly dispersed. As a rule, wettable powders are safer to use around vegetation than EC formulations because they lack petroleum-based solvents. They are generally mixed with water to form a slurry before being added to the tank mix. Wettable powder suspensions need to be agitated constantly to avoid settling of the particles. They may cause problems by clogging sprayer screens and nozzles. They are very abrasive to spray nozzles and pumps. Very hard or alkaline water may cause some difficulty in mixing wettable powders.



III. PESTICIDE COMPATIBILITY

When two or more pesticides can be mixed safely, or used in combination, they are said to be **compatible.** Two or more chemicals may be combined to:

- Increase the effectiveness of one of the chemicals; this is called **synergism.** The manufacturer usually wants to increase the activity of the pesticide formulation against specific pests. This is done by adding a chemical referred to as a **synergist,** which is not an active pesticide but which increases the effectiveness of the pesticide. Synergists usually increase the toxicity of the pesticide so that a smaller amount is needed to bring about the desired effect. This may reduce the cost of application. An example of a synergist is piperonyl butoxide (PBO), often used with pyrethroid insecticides.

- Provide better control than that obtained from one pesticide. Applicators sometimes combine active pesticides to kill a pest that has not been effectively controlled by either chemical alone. Many combinations are quite effective, but in most cases it is not known if the improved control is a result of a synergistic action or an additive effect of the several chemicals on different segments of the pest population.
- Control different types of pests with a single application. Frequently, several types of pests need to be controlled at the same time. It is usually more economical to combine the pesticides needed and make a single application. However, the compatibility of the various chemicals must be known before the materials are combined.

When two or more pesticides cannot be used in combination, they are said to be **incompatible.** Some pesticides are incompatible because they will not mix, others because even though they mix, they do not produce the desired results. Some combinations of chemicals result in mixtures that produce an effect which is the opposite of

synergism. This effect is called **antagonism** and may result in chemical reactions that cause the formation of new compounds. In other cases incompatibility may result in separation of the pesticide from the carrying agent. If one of these reactions occur, the following may result:

- Effectiveness of one or both compounds may be reduced.
- Precipitation may occur and clog the screen and nozzles of application equipment.
- Various types of plant injury (phytotoxicity) may occur.
- Excessive residues may result.
- Excessive runoff may occur.

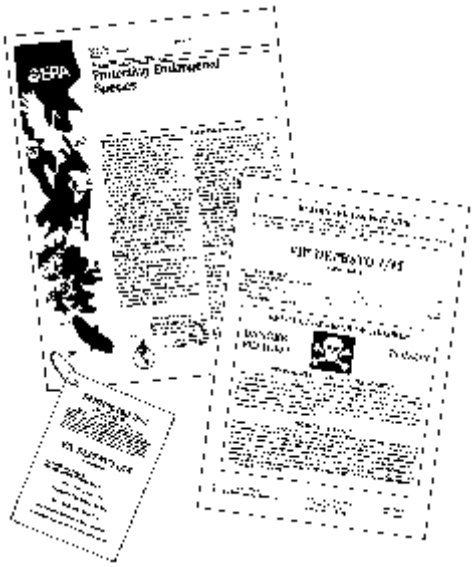
Another less familiar but extremely important undesirable effect of combining certain pesticides is **potentiation.** Some of the organophosphorous pesticides potentiate (or activate) each other. In some cases, the combination increases the toxicity of a compound that is normally of very low toxicity, so that the result is a compound that is highly toxic to non-target organisms, possibly including humans and plants.

The pesticide label will sometimes indicate compatibility problems. Some pesticide formulations are prepared for mixing with other materials and are registered for pre-mixes or for tank mixes. If this is true, it will be indicated on the label. When a combination of chemicals is to be made, refer to the compatibility charts that are available through pesticide dealers and other sources. You should also remember that when a chemical is applied, even several days after the application of a different chemical,

it may result in excessive residue, phytotoxicity, or livestock poisoning. Potentiation can be a very dangerous factor in the application of pesticides.

IV. PESTICIDES AND THE LAW

Both federal and state laws govern the use and application of pesticides. The federal law serves as an umbrella, under which state laws may be more, but not less, restrictive than the federal law. The state laws are accessible through your state Pesticide Coordinator or Cooperative Extension Service.



The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) passed in 1972, and was amended in 1974, 1978 and 1988. In 1996 the Food Quality Protection Act (FQPA) was passed as a complementary set of regulations which, among other important features, specifically recognizes the special situations and usages of pesticides for public health. These laws regulate the registration, manufacture, transportation, distribution and use of pesticides. The regulations are administered by the EPA.

Definitions under FIFRA & FQPA

Some important definitions have been promulgated under the regulations that apply to pesticide application and set the guidelines for users.

General-use Pesticide - a pesticide, or some of its uses, that is less likely to harm humans or the environment when it is used according to label directions.

Restricted-use Pesticide - a pesticide, or some of its uses, that could cause human injury or environmental damage unless it is applied by competent certified applicators who have shown their ability to use these pesticides safely and effectively. [Refer to your state Agriculture Department or Cooperative Extension Service for a current list of federally restricted-use pesticides.]

Certified Applicator - any individual who is authorized to use or supervise the use of any pesticide which is classified for restricted use. EPA requires each state to maintain a program for certification of restricted-use pesticide applicators. In order to be certified, pesticide applicators must pass a general knowledge (core) examination and then undergo a certification process in one of the designated specialty categories and pass a written examination with a minimum score of 70%. **Certification** as a public health pesticide applicator documents that the applicator has the required basic knowledge about a variety of related topics including labels and label comprehension, identification and biology of target pests, technical aspects of pesticides and their use, hazards and safety factors, methods of application, laws and regulations, environmental use considerations and, in addition, specialized knowledge of pests of public health importance, vector-disease relationships, causes of disease-host relationships and non-chemical control methods.

Private Applicator - a certified applicator who uses or supervises the use of any restricted-use pesticide for purposes of producing any agricultural commodity on property owned or rented by him or his employer, or (if applied without compensation) on another person's property. Examples: farmers, ranchers, floriculturists and orchardists.

Commercial Applicator - a certified applicator who uses restricted-use pesticides for purposes other than producing an agricultural commodity. Examples: government, forest service, licensed pest control personnel, public works and highway department workers. Commercial applicators are required to keep records of restricted-use pesticides applied on every job site of their operation. Such records are maintained for a period of two years and must be available for inspection. Mandatory information to be recorded include: brand name of the pesticide product, EPA registration number, type of formulation, percent active ingredient, scientific or common name of the target pest, dilution rate, total amount of pesticide used, total area covered, date of application, address or location of the treated area, and name of the certified applicator and the certification number.

Non-certified Applicator. This individual applies restricted-use pesticides, unless otherwise prescribed by the labeling, under the instructions and control of a certified applicator who is available if and when needed. The non-certified applicator receives specific written instructions from the certified applicator for applying the pesticide, for safety measures to be taken (including emergency procedures) and for contacting the certified applicator if necessary. The certified applicator is responsible for any violations of regulations. No person may apply a restricted-use pesticide unless certified in the category appropriate to the application or working under the direct supervision of an applicator certified in the appropriate category.

Pest. Any insect, rodent, nematode, fungus, weed or any other form of terrestrial or aquatic plant or animal life or virus, bacteria, or other micro-organism (except viruses, bacteria, or other micro-organisms on or in living humans or other living animals) which are considered pests.

Pesticide. A substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, or any substance or mixture of substances used as a plant regulator, defoliant, or desiccant.

Label and Labeling. A label is the written, printed, or graphic matter on, or attached to, the pesticide container, device or wrapper. Labeling includes the label and all other printed or graphic matter accompanying the pesticide or device.

Use of Any Registered Pesticide in a Manner Inconsistent with its Labeling. This phrase means it is illegal to use any pesticide in a manner not permitted by the labeling, provided that the term shall **not** include:

- Application at any dosage, concentration or frequency less than that listed on the labeling.
- Applying a pesticide against any target pest not on the labeling if the application is to a crop, animal, or site that is listed.
- Use any equipment or method of application which is not prohibited by the labeling.
- Mixing a pesticide or pesticides with a fertilizer, if the mixture is not prohibited by the labeling.

Registration of Pesticides.

No person in any state may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive and deliver to any person any pesticide which is not registered with the EPA. All states must accept all EPA registered restricted-use pesticides. Astate may restrict any EPA registered general-use pesticide.

The classification of pesticides and their uses by the EPA is based upon “risk assessment”. Risk assessment determination involves the potential for poisoning humans, type of formulation, the way a pesticide is used, the site of application, and the potential for environmental harm.

EPA will assign each registered pesticide a registration number. (Example: Reg. No. 012s001)

Experimental Use Permits. Experimental Use Permits (EUP) may be issued for a period not exceed one year to accumulate the necessary information and data required to register a new pesticide. An EUP is not required for aquatic areas that total less than one acre nationally or terrestrial areas that total less than ten acres nationally for a specified pest species. A tolerance of exemption under the federal Food, Drug and Cosmetic act does not need to exist. EPA may establish a temporary tolerance level if the experimental use of a pesticide may reasonably be expected to result in any residue on or in food or feed.

Registration of Establishments. Pesticides or active ingredients used in the production of a pesticide may not be produced (i.e., manufactured, prepared, compounded, propagated, processed, repackaged or undergo a change in the container) unless the establishment in which it is produced is registered with the EPA. EPA assigns each registered establishment an establishment number.

Unlawful Acts. It is unlawful in any state to distribute, sell, offer for sale, deliver, etc.:

- Any pesticide not registered by the EPA.
- Any registered pesticide whose composition or claims differ from those made in connection with its registration.
- Any pesticide which is "adulterated" or "misbranded" or any device that is misbranded. [**Adulterated** means the strength or purity falls below the standard expressed in its labeling, another substance has been wholly or partly substituted for the pesticide, or an important constituent of the pesticide has been wholly or partially left out. **Misbranded** means that the labeling: bears any statement, design, graphics, etc., that is false or misleading; the package, container, or wrapper does not conform to specific EPA standards; it imitates or is offered for sale under the name of another pesticide; its label does not bear an EPA Establishment Registration Number; any word, statement, or other information required to appear on the labeling is not conspicuously or prominently placed, so as to render it unlikely to be read and understood by the ordinary individual: or the label does not contain a cautionary statement that adequately protects health and the environment.]

It is also unlawful to:

- Detach, alter, deface, or destroy, in whole or in part, any labeling.
- Refuse to keep required records, or to refuse to allow the inspection of any records or establishment, or refuse to allow a designated employee of the EPA to take a sample.
- Advertise a restricted-use pesticide without giving the product's classification.
- Make available for use, or to use, any restricted-use pesticide for purposes other than those registered except that it shall not be unlawful to sell a restricted-use pesticide to an uncertified person for application by a certified applicator.
- Use any registered pesticide in a manner inconsistent with its labeling, or any experimental use permit contrary to the provisions of such permit.
- Knowingly falsify any required application for registration, record, information, or report; or failure to file reports required by this act.

- Add, or take, any substance from any pesticide to defeat the purpose of this act.
- Use any pesticide in tests on human beings unless they are fully informed of the consequences and freely volunteer to participate.

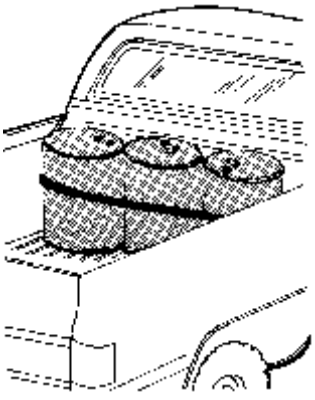
Civil Penalties:

- Any registrant, commercial applicator, wholesaler, dealer, retailer, or other distributor who violates any provision of these regulations may be assessed a civil penalty of not more than $5,000 for each offense.
- Any private applicator or other person not included in the above paragraph, who violates any provision of these regulations subsequent to receiving a written warning or a citation for a prior violation may be assessed a civil penalty of not more than $1,000 for each offense;
- Any applicator not included under the first paragraph in this section who holds or applies registered pesticides, or uses dilutions of registered pesticides, only to provide a service of controlling pests without delivering any unapplied pesticide to any person, and who violates any provision of these regulations may be assessed a civil penalty of not more than $500 for the first offense nor more than $1,000 for each subsequent offense.

Criminal Penalties:

- Any registrant, or producer who knowingly violates any provision of these regulations shall be guilty of a misdemeanor and shall, on conviction, be fined not more than $50,000, or imprisoned for not more than one (1) year, or both;
- Any commercial applicator of a restricted-use pesticide or any other person not described in the paragraph immediately above who distributes or sells pesticides or devices who knowingly violates any provision of these regulations shall be fined not more than $25,000 or imprisoned for not more than one (1) year, or both;
- Any private applicator or other person not included in the two paragraphs immediately above, who knowingly violates any provision of these regulations, shall be guilty of a misdemeanor and shall, on conviction, be fined not more than **$1,000** or imprisoned for not more than **thirty (30) days,** or both.

Exemptions of Governmental Agencies. EPA may exempt any federal or state agency from any provision of these regulations, if it is determined that emergency conditions exist which require such exemption. This provision allows the sale and use of a product for a nonregistered purpose for a specified period of time, when an emergency situation occurs.



Storage, Disposal and Transportation. The labeling of a pesticide contains requirements and procedures for the transportation, storage and disposal of pesticides. The EPA may also issue requirements for the design and disposal of pesticide containers, and the disposal of pesticide rinsate. Standards are established for removal of pesticides from containers and container rinsing, container design, labeling, and refilling, and requirements for containment of stationary bulk containers and pesticide dispensing areas.

EPA will provide advice and assistance to the Department of Transportation (DOT), in functions relating to the transportation of pesticides and hazardous wastes. DOT regulates shipments of pesticides between states and within states. DOT regulations also require that for transportation of small quantities of many commonly used pesticides, training, markings on vehicles, and shipping documents are required. [Contact the DOT regarding their specific laws and regulations.]

Authority of States (Special Local Need - SLN). This authority allows a state, under certain conditions, to register additional uses for a federally registered pesticide. These registrations may involve adding application sites, pests, or alternate control techniques to those listed on the Federally registered label.

State Primary Enforcement Responsibility. For the purposes of this act, a state shall have primary enforcement responsibility for pesticide use violations.

Other Laws and Regulations

Aerial Application. Aerial application is regulated by the Federal Aviation Administration (FAA), which judges the flying ability of pilots and the safety of their aircraft.

Emergency and Community Right-to-Know Act. Title III of the Superfund and Reauthorization Act of 1986 (SARA) stipulates procedures for emergency planning in states and localities, builds a framework for community awareness concerning potential chemical hazards and outlines requirements for submission of material safety data sheets, chemical inventory forms, and toxic release forms, and focuses on trade secret protection, citizen petitions, and information availability.

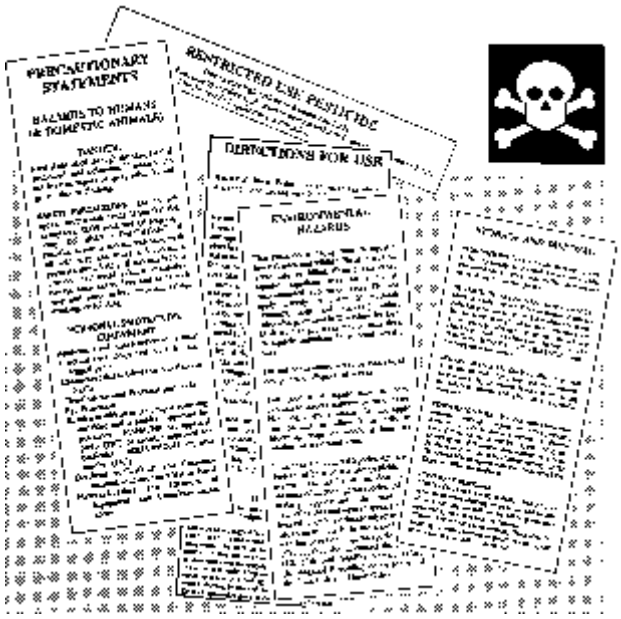
Endangered Species Act (ESA). This law sets up pesticide restrictions, beginning in 1991, related to protection of endangered species.

V. THE PESTICIDE LABEL

Most pesticide accidents result from careless use. Lack of knowledge and improper handling of pesticides can be serious shortcomings. When using pesticides, do everything possible to limit your exposure and that of the environment around you to an absolute minimum. But how is one to know how to do this? Read the label. All pesticides must bear labels that provide users with information about the product. The product must be handled in a manner consistent with the labeling. Make sure that you understand the information presented on pesticide products before you use them. **Read the labeling carefully**.

The Label is a Tool - and the Law - Learn to Use It

It is often stated the "most important few minutes in pest control is the time spent in reading the label". Label directions are regulations that must be followed exactly. **The use of pesticides in ways not in the label directions is considered a "misuse" and may result in criminal or civil penalties.** All manufacturers of pesticides must register their labels with the EPA. Label formats set by the EPA requires manufacturers to inform pesticide users of the hazards and proper application of the product. For every pesticide there is also a document known as a **Material Safety Data Sheet (MSDS)**, which provides detailed information on related hazards.



The pesticide label is designed to provide you with useful and important information which will allow you to use the pesticide legally, safely, and efficiently. However, the label is worthless if you fail to read all of it. The following are especially important times when you should review the label.

- **Before purchasing the pesticide**. Is it the proper chemical for your needs? Does the pesticide require special equipment or application techniques (which you may or may not have or know)? Do you have to have special qualifications to use the pesticide? Don't buy a pesticide just on the basis of the brand name; manufacturers change products and formulations without changing brand names. You may not be buying what you think.
- **Before mixing and applying the pesticide**. Read the label to determine how to mix the pesticide and how much to mix, what protective clothing and equipment is required, and what first aid procedures may be necessary in case of accidental exposure. Also determine from the label when and how to apply the product, the rate of application, and any residue or re-entry restrictions which apply to its use.
- **Before storing the pesticide**. Read the label for information on how to store the pesticide correctly. The label will tell you if there are any special storage precautions to follow.
- **Before disposal of unwanted pesticide or empty containers**. Read the label for instructions about the proper procedure for disposing of excess pesticide in order to avoid health risks or unwanted environmental contamination, and for decontamination and disposal of the empty pesticide container.

Scientific Basis of Label Information

The information on any registered pesticide label is the product of extensive research. As new chemicals are developed, they are screened for pesticidal properties. They are tested again and again to measure many of their important properties. Of the thousands of chemicals originally tested, only a very few will become registered pesticides. Each chemical is tested for its ability to control pest species, its toxicity, its residual qualities, its breakdown properties, and its effects on the environment.

The new chemicals are tested against a number of standard laboratory species of insects, weeds, fungi or other pests. If the chemical kills or in some other way affects the test species, scientists may make further tests to investigate the compound's toxic properties. To be registered, the pesticide must be effective on the target species without being so toxic that it presents an unacceptable hazard to the people who apply it or are exposed to it in some other way. Also, it must not be excessively harmful to non-target organisms under the conditions for which it is registered. The toxicity of each new pesticide chemical is measured using standard laboratory tests and test animals, usually rats and rabbits.

Persistence is another concern. Persistence means the length of time that the chemical remains active in the environment or in animals. Some pesticides remain on treated surfaces or in standing water for a long time, and in some cases this is desirable. In other cases, long-term persistence is undesirable. In any case, the degradation (breakdown) properties of the chemical must be known. This includes determining the length of time it takes for the chemical to degrade and what changes the chemical undergoes as it breaks down under the action of sunlight, water, bacteria, and so on. It is important to know the byproducts of chemical breakdown, because in some cases the byproducts are more toxic than the original chemical. In addition, whenever a pesticide is intended for use on a food or forage crop, tests must be performed to provide data on the amount of residue remaining after treatment and the length of elapsed time needed until the residue remaining on the crop has degraded to an acceptable level.

Pesticides are also tested for their movement in soils, ground water, and other parts of the environment and for effects on selected wildlife species. In particular, fish and birds (frequently trout, goldfish, bluegill, quail and ducks) are studied to determine whether the chemical will have an adverse effect when placed in the general environment.

Once all this information is gathered, it is submitted to various state and federal agencies for review. The governmental review is designed to insure that the pesticide is acceptable, all label claims are based upon facts supported by valid scientific data, and the label does not contain false or misleading information. The pesticide is registered after these reviews have determined the data to be accurate, complete, and within prescribed limits. Only after this registration can the chemical be made available on the open market for controlling the pests or for treating the crops or animals on which it was tested.

Nine Required Parts of a Pesticide Label

Ingredient statement. The label must give the name and percentage by weight (not volume) of each active ingredient and the percentage by weight of all solvents or adjuvants (inert ingredients) in the container. Ingredients must list chemical and/or common names of each active ingredient, but inert (non-active) ingredients need not be identified.

Net contents. The net contents indicates how much of the product is in the container. Quantity of pesticides by volume and by weight of active ingredient, e.g., in pounds per gallon, are given in the net contents. The weight of active ingredient is necessary for dilution calculations which are based on the weight of active ingredient in the formulation.

Name, brand or trademark. The name, brand or trademark under which the product is sold must be on the front panel of the label. Refer to the chemical name or common name in case of poisoning or when seeking additional information on the product. Reference manuals provide specific information about treatment for poisoning by the active ingredient using the chemical or common names.

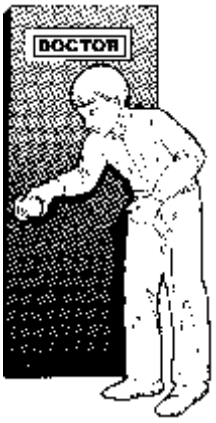
Brand names are names given pesticides by manufacturers for advertising and promotions. Different manufacturers of the same pesticide will sell their product under different brand names. Spectracide® is an example of a brand name for the pesticide diazinon. The brand name does not give an indication of what active ingredient the product contains and, therefore, is not a good method for identifying a pesticide in case of a poisoning.

Chemical names are names that describe the formula, or chemical structure, of the pesticide according to international rules for naming chemicals. O, O-diethyl O-(2-isopropyl-6-methyl-4- pyrimidinyl) phosphorothioate is the chemical name for diazinon.

Common names are official or generic names assigned to pesticides. Identification of pesticides is made easier through the use of their common names. Diazinon is the common name for the brand name Spectracide and the chemical name 0, 0-diethyl-O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate.

Formulations such as emulsifiable concentrates, wettable powders, dusts, etc., usually appear as abbreviated letters preceded by a number that specifies the percentage or weight in pounds of the active ingredient: (80W = 80% wettable powder; 4E = 4 lb emulsifiable concentrate).

Precautionary statements. Precautionary statements inform the user of the proper precautions to take to protect self, others, domestic animals and the environment from harmful effects of pesticide exposure. Hazard statements help the user apply the pesticide correctly. Precautions must include **signal words** to identify hazards to humans or provide a child hazard warning and may require additional precautionary information.



- Human Hazard Signal Words - indicate the level of toxicity of the pesticide:
  - DANGER - A taste to a teaspoonful taken by mouth could kill an average-sized adult.
  - WARNING - A teaspoonful to an ounce taken by mouth could kill an average-sized adult.
  - CAUTION - An ounce to over a pint taken by mouth could kill an average-sized adult.
- Child Hazard Warning - to advise persons caring for children:
  - "Keep out of reach of children" - this notice must be on the front panel of the label for all pesticides.
- Hazards to Humans and Domestic Animals - where a hazard exists to humans or domestic animals, precautionary statements are required indicating the particular hazard, the route or routes of pesticide

exposure to humans (i.e., mouth, skin, lungs) and specific actions to take to prevent pesticide exposure, accident, injury or damage (e.g., protective clothing, facial masks).

- Environmental Hazards - if a pesticide is markedly hazardous to wildlife, the label must bear special toxicity statements. General environmental precautions may include: "Do not apply directly to water", or "Do not contaminate water, food or feed by storage and disposal of the pesticide". Specific guidelines may be listed, for example:

  "This pesticide is toxic to fish" is required if a pesticide intended for outdoor use contains an active ingredient with an acute LC_{50} of 1 ppm or less for fish.

  "This pesticide is extremely toxic to wildlife" is required if either accident history or field studies demonstrate that use of the pesticide may result in fatality to birds, fish, or mammals.

  "This pesticide is highly toxic to bees" is required for foliar application to agricultural crops, forests, shade trees, or mosquito abatement treatments whenever a pesticide is toxic to pollinating insects.

  "Keep out of lakes, ponds or streams: do not contaminate water by cleaning of equipment or disposal of wastes" is required for all outdoor pesticide uses other than aquatic applications.

- Physical or Chemical Hazards - these statements provide information about the flammability or explosive characteristics of the pesticide. Warning elements on the flammability or explosive characteristics of a pesticide and required as established by FIFRA.
- Statement of Practical Treatment - to advise on first aid measures. First aid or other treatment is required on the front panel of the label for all pesticides falling into toxicity Category I for oral, dermal and inhalation toxicity. Pesticides in other categories must also have the statement of practical treatment, but it need not be on the front panel. The statements can include information such as signs and symptoms of poisoning, first aid, antidotes, note to physicians in the event of a poisoning, etc.

Directions For Use. Label directions on how pesticides are to be used must be followed exactly. Amendments that interpret "inconsistent with label directions" are applicable only if the label specifically does not contain "do not," "only for," or other prohibitive statements. The following directions are required by law on all labels.

- The site of application. Pesticides cannot be used on sites that are not listed on the label. The following are sites frequently mentioned on labels of pesticides used in public health applications.

  Definition. Spot treatment: non-continuous applications of pesticides to areas not exceeding 2 ft^2. The area treated may be of any shape as long as it does not exceed the 2 ft^2 limit.

  Definition. Crack and crevice: narrow spaces and gaps in walls, moldings, and cabinets indoors where insects may hide.

  Definition. Food Area: any area where food or feed is stored, prepared, or consumed.

- The target pest associated with each site. Unless labels specifically state "use only for" pests listed on the label, the pesticide may be applied at the same rate for other unlisted pests as long as the site is mentioned in the label.
- The dosage rate associated with each site or pest. Less pesticide may be used than the label directs but the dosage rate specified in the label must not be exceeded.

  Definition. Acre foot: labels that specify dosages for acre foot in aquatic applications must be adjusted for the depth of water. Label dosages calculated for an acre foot of water with a depth of one foot must therefore be doubled for an acre of water with a depth of two feet. Depth of water in dosage calculations may be used only if the label specifies acre foot
- Method of application. Label directions must be followed exactly whenever methods of application, dilution, and equipment are specifically given. Products with labels without specific application or dilution instructions may be applied or diluted by any method not prohibited on the label.

  Definition. Diluent: the material that concentrated pesticides are diluted with before application. It is a violation of label direction if a diluent not specified on the label is used.

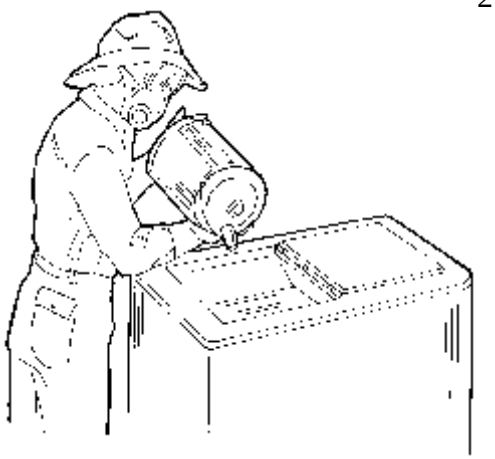
  Definition. Dilution rate: labels specifying dilution rates must be followed exactly. Labels only specifying amount of concentrate per unit area may be diluted at calibration rates of the application equipment.
- Frequency and timing of application. To obtain effective results without causing unreasonable adverse effects on the environment, pesticides may be applied less frequently but never more frequently than the label directions.
- Re-entry to areas where pesticides have been applied. Labels specifying time limits for entering treated areas must be followed to prevent contamination of workers or the public.
- Storage and disposal of pesticides and containers. Instructions in the storing and disposal of pesticides and their containers must be followed to prevent environmental contamination and accidental poisoning of people.

  Definition. Labeling on pesticide containers other than the original labeled container must include the following information: Name, Address, and Telephone Number of Pest Control Firm; Product Name; EPA Registration Number; Name and Percentage of Active Ingredient; Signal Word from Label.

  Definition. Label requirements for containers holding ready-to-use (RTU) diluted pesticides: Name, Address, and Telephone Number of Pest Control Firm; Product Name, followed by word "DILUTED"; EPA Registration Number, preceded by "derived from"; Name and Percentage of Active Ingredient as Diluted; Signal Word from Registered Label.

  Definition. Other requirements for service container use. A copy of the full pesticide label must be available on the vehicle or premises whenever service containers are used. Service containers] must conform to package requirements of pesticide, e.g. , do not use empty food containers to hold pesticides.

VI. PESTICIDE HANDLING



Properly used, pesticides are an important positive factor in our quality of life. Improperly used, pesticides can poison people, pets and livestock; they can damage populations of beneficial insects, birds, fish and other wildlife; and they can harm desirable plants. It is necessary to maintain careful and continuous control over the use and handling of these chemicals during transport, storage, mixing and loading, application, equipment cleaning and disposal.

Packaging

Pesticides are packaged in a variety of containers, from pint-size or smaller containers to 55-gal drums and bulk fiberglass containers holding upwards of 1,000 gal. Dusts, wettable and soluble powders, granules, and other solid formulations are packaged in everything from small cellophane-wrapped packs and lined paper bags to cardboard and plastic containers and drums. Liquids are packaged in plastic, glass, or metal containers; the choice of container is often dictated by the reactivity or corrosiveness of the liquid. Aerosols usually come in reinforced metal containers and cylinders. The variety of packaging materials, shapes, and sizes is endless. Pesticide recognition by container packaging is helpful, but the final authority on the nature of the chemical is the product label itself.

Transport

Pesticides can present a critical hazard if they are involved in accidents during transport. When pesticides are spilled on the roadway, they may catch fire, be scattered by passing cars and trucks, be blown by wind onto nearby crops or people, or be washed into ditches or streams by rain. If they catch fire, the fumes and smoke may injure firefighters and police, and may threaten people far removed from the site. Less spectacularly, but equally hazardous, pesticides may simply contaminate the vehicle, cargo, or people transporting the chemicals. When you transport pesticides, you are legally responsible for them. Taking the following precautions will help prevent accidents:

- Secure all containers to prevent any spillage.
- Protect containers made of paper, cardboard or similar materials from moisture.
- Protect glass containers from breakage.
- Transport pesticides in the back of a truck.
- Do not transport pesticides in the passenger compartment of any vehicle or in the same compartment with food, feed, or clothing.
- Do not allow children to ride in the back of a pick-up truck with pesticides.

Mixing and Loading Pesticides

Many pesticide accidents occur when the chemicals are being mixed for use. The most dangerous activity associated with pesticides is the pouring and mixing of concentrated chemicals. Organophosphate insecticides are the most hazardous pesticides in this respect and, when these insecticides are in xylene, they present the most

serious safety hazards. Low-volume and ultra-low volume dilutions are the most hazardous to load because they are the most concentrated. A few common sense rules can make mixing and loading safer, thereby helping to avoid the leading cause of pesticide-related illnesses:

- Before handling, read the label for instructions on special hazards.
- Use appropriate protective clothing and equipment.
- Mix pesticides outdoors, in a place where there is good light and ventilation. If you must mix or load pesticides indoors or at night, make sure there is good ventilation and lighting.
- Stand upwind of the pesticide to avoid contaminating yourself.
- Use a sharp knife to open paper bags; do not tear them.
- Measure accurately, using only the amount specified on the label.
- When removing the concentrated material from the container, keep the container below eye level to avoid splashing or spilling any pesticide into your face and eyes.
- If you splash or spill a pesticide while mixing or loading, stop immediately - remove contaminated clothing, rinse the exposed skin thoroughly with water and then wash thoroughly with detergent and water. Speed is essential when you or clothing are contaminated. Clean up the spill.

Storage

Pesticides should be stored only in facilities where due regard has been given to the toxic nature of the pesticide, site selection, protective enclosure, the number and sizes of containers to be stored, operating procedures, and where adequate measures are taken to ensure personal safety, ventilation, accident and fire prevention, and detection of potential environmental damage. When practicable, sites should be located where flooding is unlikely and where soil conditions and geological / hydrological characteristics will prevent the contamination of any water system by runoff or percolation. Warning signs are required where Category I and Category II poisons are stored. The floor should be smooth cement (no cracks or crevices) painted with a hard sealer and shaped to contain spills and simplify cleaning them up. Where relevant and practical, the following precautions should be taken:

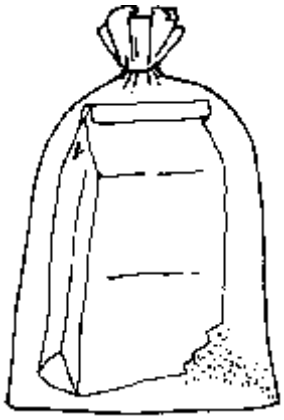
- Secure the storage facility with a climb-proof fence and lock doors and gates to prevent unauthorized entry.
- Store rigid containers in an upright position and store all containers off the ground in an orderly way, so as to permit ready access and inspection.
- Pesticides must be stored in their original, labeled container with the label clearly visible. Do not store any amount of pesticide in old bottles or food containers where they could be mistaken for food or drink for humans or animals.
- Do not store pesticides near food, feed or seed.
- Store pesticides in tightly sealed containers. Check periodically for leakage, corrosion, breaks, tears, etc.
- Store pesticides where they are protected from moisture, freezing or excessive heat.
- Be certain that storage areas are well ventilated to prevent the accumulation of toxic fumes.
- Store herbicides and insecticides, which are often incompatible, separately in tightly closed containers in order to avoid cross contamination or adverse reactions that might cause hazardous fumes or conditions.
- Place identification signs on rooms, buildings, and fences to advise of the contents, warn of their hazardous nature and provide emergency phone numbers.

- Post emergency procedures (for fire, spill, personal contamination, etc.) conspicuously near work areas and exits and a complete inventory of the pesticides on the outside of the storage area, along with the name and phone number of the responsible supervisor and building custodian, and update these as needed.
- Where large quantities of pesticides are stored, inform the local fire department, hospital, public health agency, emergency response program and police department in writing of the hazards that such pesticides may present in the event of a fire. A floor plan of the storage area, indicating where different pesticide classifications are regularly stored, should be provided to the fire department.

Keep all corrosive chemicals in proper containers to prevent leaks that might result in serious damage. Even the simple step of tightly closing lids and bungs on containers can help extend the shelf life of pesticides and provide a safer working environment.

Over a period of time containers may develop leaks, breaks, or tears, so check them often for such problems. If a damaged container is found, transfer its contents to a clearly labeled overpack container or to one that held the same formulation previously. Partially empty paper containers should be sealed with tape or staples. All newly opened or overpack containers should be dated at the time they are first used for tracking and inventory purposes.

When receiving pesticides, date them and keep a current inventory of supplies. Avoid stockpiling. Purchase what you need, but not to excess. This eliminates waste and the problem of what to do with old materials. Even with careful planning it may sometimes be necessary to carry pesticides over from one year to the next. Check the dates of purchase at the beginning of each season, and use the older materials first. To protect the label on a container and to keep it intact and legible, cover it with transparent tape or lacquer.



No pesticide, pesticide container, pesticide-related waste, or pesticide container residue should be stored or disposed of in a manner inconsistent with its label or labeling, or in a manner so as to cause or allow open dumping, open burning, water dumping or ocean dumping (except in conformance with appropriate state and federal regulations), direct exposure that could result in contamination of food or feed supplies, or violations of any applicable federal, state, or local pollution control standard, or FQPA regulations .

Labeling Requirements for Stored Pesticides.

Every pesticide product is required to bear a label, whose words must be prominent and legible and affixed to the pesticide container. Excess serviceable pesticide may be reused or sold for pesticidal purposes only if it has a complete, EPA-approved label on its container and only if the product has not deteriorated or had any substance added to it. Unserviceable pesticides are those which lack proper labeling or which have had their composition altered. These pesticides should be labeled "FOR DISPOSAL ONLY" on the container.

Suspended and canceled use pesticides, and those whose labels have become obliterated or mutilated must be considered unusable unless revised labeling can be procured from the manufacturer. It is legal to obtain an amended label from the manufacturer to be placed on the container. However, the manufacturer must provide written approval to affix this label onto the container. If a manufacturer is unable to provide an amended label, or if the manufacturer is out of business, then the product must be declared unserviceable and for disposal only. Pesticides with no suspended or canceled uses can be legally shipped or transferred as long as they are in approved containers.

Repackaged pesticides cannot be redistributed unless designated for disposal only, or for return to the manufacturer.

Combustible and Flammable Liquids.

In addition to regulations that dictate procedures for the storage and handling of pesticides as toxic or hazardous materials, additional requirements must be considered when storing liquid pesticide formulations classified as combustible or flammable liquids. These requirements should be incorporated into new or existing pesticide storage facilities. Should a requirement differ from a similar requirement for handling toxic or hazardous substances, the more stringent requirement should be followed.

Shelf Life

Given proper storage, some pesticides may remain active for several years. However, storage conditions vary so widely that it is difficult to predict long-term shelf life for a pesticide product. This is one reason most pesticides are not backed by the manufacturer if stored longer than two years, so plan for every purchase of pesticides to be completely used within this two year period.

Although pesticides are manufactured, formulated, and packaged to exacting standards, they can break down in storage, especially under conditions of high temperature and humidity. Some pesticides lose active ingredients due to chemical decomposition or volatilization. Dry formulations become caked and compacted and emulsifiable concentrates may no longer form emulsions. To make matters worse, some pesticides convert into more toxic, flammable or explosive substances as they break down.

Containers have an important effect on the storage and shelf life of pesticides. Many kinds of fiber and metal drums, pails, cans, bottles, bags, boxes, overpacks, liners, and closures are used to package pesticide chemicals. If stored for long periods (years), these containers may eventually degrade. Also, that important document, the label, may become illegible.

Pesticide formulations that contain low concentrations of active ingredients generally lose effectiveness faster than more concentrated forms. Sometimes a liquid pesticide develops gas as it deteriorates, making opening and handling the container quite hazardous. In time, the gas pressure may cause explosive rupture of the container. Certain pesticide chemicals have a characteristic odor, and if this odor grows stronger in the storage area it could indicate a leak or spill, a defective closure or an improperly sealed container. It may also be a clue that the pesticide

is deteriorating, since the smell of some materials intensifies as they break down in storage. If none of these problems are found, chemical odors can be reduced by installing an exhaust fan or lowering the temperature of the storage area.

Fewer problems occur with stored pesticides and the products have a longer shelf life if the storage area is cool, dry and out of direct sunlight. Protection from temperature extremes is important because either condition can shorten the shelf life of pesticides. At below freezing temperatures some liquid formulations separate into various components and lose their effectiveness. High temperatures cause many pesticides to volatilize or break down more rapidly. Extreme heat may also cause glass bottles to break or explode.

Other characteristics of a pesticide product also affect its shelf life. These include the formulation (liquid concentrate, wettable powder, granules, etc.), the types of stabilizers and emulsifiers used, and the type of container and its closure.

Pesticides as Hazardous Materials

All pesticide formulations are classified as hazardous wastes for purposes of disposal. A pesticide is a hazardous waste if it is listed by the EPA (40 CFR, Part 261) or meets the specifications for ignitability, corrosivity, reactivity or extraction procedure toxicity. An installation that generates hazardous waste is classified as a Small Quantity Generator (SQG) if between 1 and 100 kg per month of a hazardous waste or between 0 to 1 kg per month of an acutely hazardous waste (as defined by the Resource Conservation and Recovery Act; RCRA) is generated. An SQG must comply with RCRA regulations governing the handling, storage, and disposition of hazardous waste.

EPA has determined that "returned commercial chemical products" such as off-specification or outdated products, broken bags, etc., are not "wastes" in the hand of customers, distributors, or middlemen, provided they are being returned to the manufacturer's location for recycling or eventual disposal. Because they are not wastes, they would not count toward the monthly volume ceilings for SQG status. The products must be returned to the manufacturer. If they are discarded or sent elsewhere for disposal, they are wastes and may be hazardous wastes.

Identify those pesticides for which disposal of the product or related waste may constitute disposal of a hazardous or acutely hazardous waste. [Even if a pesticide is not listed as a hazardous waste in 40 CFR 261, it requires handling and disposal in accordance with its label and 40 CFR 165.] Each agency should develop a management plan for the disposition of all serviceable and unserviceable pesticides, pesticide containers and pesticide-related wastes.

Disposal Methods for Pesticide Wastes.

Users of pesticides must dispose of potentially hazardous pesticide containers. Landfills cannot accept waste classified as hazardous under RCRA). Some pesticides, and consequently their containers, fall into this category unless the container is properly rinsed. Fortunately, the proper handling and disposal of a waste pesticide container is not difficult. Rinsing and disposing of waste pesticide containers correctly:

- Protects humans, pets and livestock from hazardous materials.
- Minimizes user liability.
- Prevents environmental contamination, protecting animal habitats and water sources.
- Saves money by putting all the product into the spray tank to be used during application.
- Allows convenient and inexpensive recycling of cleaned containers.
- Eliminates the need for hazardous waste storage facilities.

Read the label, follow the directions and wear the approved personal protective equipment when rinsing and disposing of the container. Protect your eyes, mouth, nose and skin by wearing goggles or a face shield, a long-sleeved shirt and chemical-resistant gloves. Coveralls, a chemical apron and chemical resistant boots protect you from spills and splashes. Avoid breathing pesticides whenever possible. Stand up-wind to a breeze. Some liquid and many dust formulations require that a respirator be worn. Remember that chemicals are most toxic or dangerous in their undiluted concentrated forms. The original product is more dangerous than the container rinse water, which in turn is more toxic than the diluted spray applied to control pests.

Protect yourself and the environment by cleaning the container completely. Use the rinse water to finish filling the sprayer supply tank. If you cannot use the rinse water, collect it for later use in a spray mix or for disposal as a hazardous material. Make sure it is correctly labeled. Save containers cleaned for recycling or disposal in a locked facility. Do not leave a rinsed container haphazardly lying around.

Waste materials should be considered hazardous to the public, the people handling them and the environment. Deciding how to dispose of pesticide wastes should be done on a case-by-case basis. Consult the manufacturer of the chemical, if possible, for special instructions regarding disposal. Some pesticide manufacturers may accept small amounts of waste for disposal at the factory.

Container categories. Pesticide containers for disposal are classified into three main types: those that will burn (Group I), those that will not burn (Group II) and those that contained mercury, lead, cadmium, arsenic or inorganic pesticides (Group III). Any pesticide container which can be rinsed should receive triple-rinsing, especially if it contained an RCRA designated hazardous material. Group I (combustible) containers may be disposed of by being burned in an approved pesticide incinerator or buried in aspecially designated landfill. [Do not burn combustible containers in an open field or non-pesticide incinerator.] Group II and III pesticide containers should be triple-rinsed before taking disposal action.

Empty pesticide containers are not really "empty" because they still contain small amounts of pesticides, even after they have been rinsed properly. A container that previously contained a non-hazardous or hazardous pesticide is considered "empty" if it contains no more than one inch of residue on the bottom of the container or inner liner. A

container that previously contained an acutely hazardous pesticide is considered "empty" only if it has been triple-rinsed with an appropriate solvent, cleaned by an equivalent method approved by the EPA Regional Administrator, or had the lining removed.

Triple-rinsed Group II (non-combustible) metal drums in good condition may be recycled through a registered drum reconditioner or returned to the pesticide manufacturer for refilling with the same chemical class of pesticide. Properly rinsed metal containers may be punctured to facilitate drainage prior to transport to a facility for recycling as scrap metal or for disposal. All rinsed containers not disposed of in the above manner should be crushed or otherwise rendered unusable and buried in a sanitary landfill in conformance with federal, state and local requirements. Glass containers should be carefully broken and stored. Plastic containers should be cut apart to render them unusable and to take up less room. An empty 55 gal drum makes a good storage container for smaller empty or broken containers. The drum should be covered tightly and when full, can be buried in a proper sanitary landfill.

Cleaning pesticide containers. Pesticide container disposal is a significant problem. For current regulations concerning the disposal of any pesticide container, contact your County or State authorities. Before disposing of any metal or glass pesticide container, it must be rinsed. Follow this **triple rinse** procedure.

- Empty the “empty” container into the mixing tank and allow the pesticide to drain for an extra 30 seconds. Before filling the mixing tank to the desired level, add the following amount of water to the container for thorough rinsing as follows:

Container capacity less than 5 gal	Rinse with 1/4 container volume
Container capacity 5 gal or more	Rinse with 1/5 container volume

- Replace the container closure and then rotate and shake the container, upending it in the process so that the rinse reaches all interior surfaces.
- Drain the rinse solution from the container into the mixing tank. Allow the container to drain for an extra 30 seconds after emptying.
- Repeat this rinsing procedure at least two more times for a total of three rinses. When triple rinsing will not sufficiently clean the container, keep rinsing until the rinse water from the container runs clear. After the final rinse, puncture metal containers on the top of the rim to allow remaining rinse solution to drain (unless the container is to be recycled through a registered drum reconditioner - in which case the drum should not be punctured).
- Remember - it is important to empty each rinse into the mixing tank so that the pesticide goes on the target for which it is intended. (This procedure is also a money saver!)
- Now that the triple rinse procedure is completed, fill the mixing tank to the desired level.
- Use the rinse water in the spray mixture you are making up. This is the safest procedure for you and the environment, creates less waste, and is cost-effective. If you collect rinse water for later use or disposal, do not mix pesticides from different rinse waters. Label each rinse water container so you know what is in it.
- Do not dump rinse water on the ground or down a drain, especially a storm drain or into the sewer.

Stencil "TRIPLE RINSED" prominently on the side of the container. If the container is not recyclable, puncture it several times to prevent its use for other purposes. Dispose of punctured, damaged, or otherwise unrecyclable pesticide containers in landfills in conformance with federal, state and local regulations. Rinse liquids from the internal flushing of pesticide containers, sprayers or tanks may be added to spray mixtures as diluent, provided that the rinse liquid is compatible with the pesticide being mixed. Use these rinse liquids in this manner to avoid generating waste. Rinse liquids from external equipment washing or those not otherwise applied or used as diluent for subsequent spray mixes must be properly processed through a filtration system or be considered pesticide-related wastes. If the material is waste, it must be disposed of as an unserviceable pesticide.

If an empty pesticide container is used to hold excess rinse solution, the previous label must be removed; and the container must be relabeled, designating that it now holds waste material and the type of waste it contains. All safety precautions that apply to pesticides also apply to this material.

An alternative to triple rinsing is **pressure rinsing**, which continuously washes the inside of the container, preferably into the spray tank. A pointed, sharp pressure nozzle is used to puncture and rinse the container in one step. It is easier and more effective than triple rinsing. Empty the pesticide into the spray tank. Let it drain for 30 seconds. Puncture the lower side of pesticide container with the pointed rinse nozzle. Hold the container so that the mouth is over the spray tank**.** Rotate the container to rinse all the inside surfaces. Rinse until rinse water is clear.

Paper or Plastic Sacks and Bins and Fiber Containers. Empty the contents completely into the application equipment. You may need to cut the container to remove the material in the seams. Do not rip or tear the container. Instead, use scissors or a knife (but not your personal pocketknife). Wear appropriate personal protective equipment such as gloves, eye protection, long-sleeved coveralls and in some cases, a respirator. In that case, read the label - a dust mask may be sufficient. Do not let material blow around. Triple rinse the container if you can. Some containers have plastic or foil liners that will allow you to rinse them. Use the rinse water in the spray mixture or collect it for disposal.

Do not burn containers unless the label allows it. Even then, it may be against the law if a local ordinance prohibits burning such products. Burning can release toxic fumes that damage eyes, nose and lungs and cause illness. When burning, avoid the smoke and keep others out of the smoke.

Only pesticide container recyclers can accept plastic pesticide containers. Only "clean", triple or power rinsed containers are accepted. Remove caps, which are a different class of plastic and can be disposed of in your normal trash. Remove plastic labels and sleeves, but paper labels may remain attached. All containers will be inspected, both inside and outside. Stains are acceptable, but residues are not.

Do not put cleaned containers into the normal trash. Recyclers may pick them out and put them with other recycled plastic. Do not put them in traditional recycling bins or take them to urban recycling facilities where plastic soda and milk bottles or other food containers are accepted.

Only cleaned containers can be accepted in landfills. Even after rinsing, the washed container still contains some pesticide and should not be considered safe for other uses. Do not put any other pesticide into the empty container. Many containers should be discarded after one use. Some landfills visually inspect containers and/or require written verification by county health or state department of agriculture officials as to the cleanliness of the containers.

Never abandon empty pesticide containers. Uncleaned containers can be very dangerous to people, animals and the environment. It is against the law to abandon pesticide containers, even cleaned ones. Burying of empty, uncleaned containers or unused product is unsafe. Even small amounts of pesticide can reach water supplies or contaminate the soil.

When purchasing pesticides, know how you will dispose of the container.

Disposal of unused and excess pesticides. Disposing of unused (still in the original container) and excess (already mixed, but not needed) pesticides is a critical problem, particularly if you have a large amount of unwanted chemical. If you should end up with
unused or excess pesticide, try to find another person or area with the same pest problem, so that the pesticide can be used legally and effectively. If you cannot find another area with the same problem, you might decide to locate an authorized disposal site for your unused or excess chemicals. County or State authorities have specific information on the most up-to-date legal disposal methods and pesticide dump sites.

The best precaution against pesticide disposal problems is good planning, which begins with buying and mixing the right amount of pesticide to meet your needs. To reduce the amount of waste materials that need to be managed, strive to maintain only the quantity of pesticide you intend to apply. Although there will still be containers to dispose of, you will not end up with small amounts of pesticide in containers that require storage. Extra or leftover product often may not be used for years, and in the end it still will have to be disposed of properly.

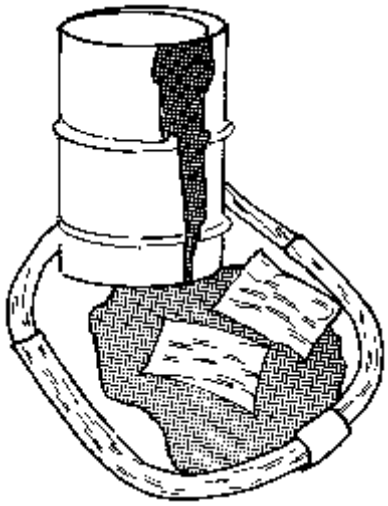
Equipment Clean-up

After completing the application of any pesticide, immediately clean the mixing, loading, and application equipment. The cleaning operation can be somewhat hazardous if proper precautions are not followed. People who clean the equipment must know the correct procedures, and wear the appropriate clothing, including rubber boots, goggles, apron and gloves. The actual cleaning should be done in a specific area, preferably on a wash rack or concrete apron that has a well-designed sump to catch all contaminated wash water and pesticides for later disposal. State regulations may require that pesticide application equipment have special continuous or jet rinse capabilities. For additional information on these requirements contact your County or State authorities.

VII. PESTICIDE SPILLS

In spite of the most careful use and handling of pesticides, accidental spills occasionally occur. These range in size from small spills of a household pesticide container to major events during transport. Pesticide spills require immediate action to avoid health impacts and to minimize contamination of property and the environment. Intelligent planning, knowledge of the chemicals involved, and calm advance consideration of the actual hazards to be dealt with during the emergency will reduce the risk of damage resulting from the accident.

When a spill occurs, it should be cleaned up as quickly and safely as possible. After the clean-up is completed, the affected area should be decontaminated immediately and returned to its original condition. A few general rules apply to pesticide decontamination situations:



- If the spill involves a public area, such as a highway, notify the city police, county sheriff, fire department, the state highway patrol, or other local emergency services agency.
- While waiting for emergency personnel to arrive, do what you can to prevent exposure of people and animals to the pesticide. Take immediate steps to see to it that no one is exposed or contaminated by accidentally walking into the spill or breathing the fumes.
- If the spill is on private property, such as at a home or on a farm, begin cleanup procedures immediately. Start by putting on protective clothing to prevent self-contamination.
- Stop the spill. Do whatever is necessary, such as uprighting the container, to limit the spill.
- Confine a liquid spill to prevent spread by encircling it with a dike of sand or absorbent material - anything that will soak up the pesticide. Work or rub the material into the pesticide either by broom or boot to absorb as much as possible. When absorbed, sweep up the material and place it in plastic bags.
- Cover dry spills with secured tarpaulins, if possible. As soon as possible, sweep up the spill and place it in plastic bags. Avoid brisk movements to keep dust from swirling into the air. Under windy conditions, lightly moisten the pesticide.
- Work in a well ventilated area because most pesticides liberate toxic vapors. Open enclosed areas to prevent the accumulation of toxic vapors while working. If it is impossible to ventilate, do not proceed with cleanup until self-contained breathing apparatus is available. Do not work alone. Remain within sight of a work partner.
- Decontaminate the affected surface. You should consult the label for specific disposal and decontamination instructions. Take care to prevent the wash from spreading and contaminating a larger area.
- Spills should be reported to the responsible County and State authorities.

Remember: if you know that the spilled pesticide is a highly toxic material, you could save lives simply by insisting that no one drive or walk through the spilled material. When emergency service personnel arrive, tell them about the nature of the chemical. Explain to them what you know about the pesticide involved. If it is a toxicity Category I or II pesticide, their lives may depend on your warning!

Cleanup operations will generate a wide variety of pesticide-related wastes and contaminated materials such as rags, absorbents and soil. These wastes should be contained in plastic bags, pails, or open-head drums. A spill or a pesticide is not considered to be a "generation" of hazardous waste. However, the cleaning up of the contaminated soil or water is considered "generation" of a solid (and possibly hazardous) waste. Thus, a spill and its correction may add substantially to the disposal burden and must therefore be handled in both a rapid and knowledgeable manner

VIII. PESTICIDE FIRES

Fire involving pesticides may create unique problems. The usual hazards presented by a fire are compounded by the danger of pesticide poisoning and widespread environmental contamination. Proper planning and training can greatly reduce the personal harm and environmental damage possible from a fire involving pesticides.

Pre-fire Planning.

The success of minimizing hazards to health and the environment during a pesticide fire may depend upon adequate pre-fire planning. Time-consuming preparatory activities and difficult decisions should be made in advance rather than during an emergency situation. All applicable organizations, particularly the fire department, should participate in the preparation of the pre-fire plan. A single individual or entity (e.g., safety officer, fire department) should prepare and coordinate the plan and put it into writing so that all appropriate organizations can be notified. The plan should be updated at least annually, or more frequently if major changes of pesticides stored or modifications to the facility are made. An added benefit of pre-fire planning is that potential hazards are often identified and eliminated. The pre-fire plan should represent a detailed analysis of the installation's procedures to handle a toxic chemical fire and should address the following points.

- **Facility floor plan**. Include a floor plan of the facility which indicates the location of permanent inside walls and external openings, such as doors and windows. Storage areas should be identified by type of pesticide and the mixing area should be clearly identified.
- **Pesticide inventory**. A copy of the current pesticide inventory should be provided to the local fire department. Updates to this list should be provided quarterly, if warranted.
- **Access routes**. Primary and alternate access routes to the pesticide facility from all directions should be included because primary access may be blocked by toxic smoke. Smoke from a pesticide fire is not just a nuisance that can be driven through, it must be presumed to be highly toxic.
- **Evacuation routes**. Routes approved by the police should be identified. Evacuation routes, must be developed in all directions so that toxic smoke can be avoided. The plan should also include procedures to secure the area to prevent unauthorized entry.

- **Water runoff control**. Planning water runoff control is a very important part of pre-fire planning. Identify where there is a potential for water runoff and determine how to prevent contamination of waterways. Arrangements for equipment and supplies necessary to construct dikes or dams should be included in the pre-fire plan. Do not rely solely on equipment and supplies located at or near the pesticide facility as they may be inaccessible because of toxic smoke.
- **Map of area**. Provide a map or a drawing of the area surrounding the pesticide facility. The map should include: location of water supplies; perimeter fences, with all gates shown; adjacent buildings/activities with contents/functions of each shown; nearby ditches, underground drains, creeks and rivers with arrows to show direction of flow; building access and evacuation routes; where and how the water runoff may be blocked; and a north arrow.
- **Emergency telephone numbers**. Include a list of telephone numbers where key personnel can be contacted day or night. As a minimum this list should include the following:

  911
  Installation security staff
  Facility pesticide supervisor
  A physician familiar with pesticide poisoning
  Chemical Transportation Emergency Center (800-424-9300; notifies manufacturers)
  Emergency numbers on the pesticide labels
  Regional US Environmental Protection Agency (EPA) Office
  Responsible State agency
  Emergency Response Program
  Coast Guard, if water runoff can reach a waterway

- **Medical Assistance**. The pre-fire plan should make provisions for medical assistance to personnel contaminated with pesticides. Local hospitals and poison control centers must be aware of the hazards of a pesticide fire so that poisoning or other pesticide-related illnesses can be properly treated. There should be plans to establish a first-aid center near the fire site, if warranted, to provide medical checks to firefighters or others as needed. Verify that current treatment procedures are known and that appropriate antidotes are locally available.
- **Salvage/hazard evaluation**. Salvage vs. hazard assessments are made to predict whether to let the facility burn in the event of a fire. The evaluation balances the salvage value of the facility and its contents against the hazards of fighting the fire, including widespread contamination by water runoff, toxic fallout from contaminated steam, and toxic compounds released into the air from the incomplete combustion of the pesticides. If the decision cannot be made during pre-fire planning, then an agreement should be prepared (in writing) with the fire department which allows the on-scene commanding officer of the firefighting unit to determine whether or not to let the facility burn.
- **Safety briefings**. The pre-fire plan should make provisions for periodic safety briefings for all appropriate personnel. These briefings should include, as a minimum, review of the plan, familiarization with first-aid procedures and symptoms of \pesticide poisoning.
- **Informing emergency organizations**. A copy of the pre-fire plan and each annual update should be provided to each emergency organization or service that would be involved in a pesticide fire.

Fighting the Fire

When a fire is discovered, all nearby personnel should be alerted and the fire department contacted. Fight the fire only if it can be done safely; otherwise evacuate to an upwind position. When fighting the fire, appropriate personal protective equipment must be worn. While not all pesticides are flammable, they may decompose in the heat of a fire and release toxic gases, vapors, and smoke. Pesticide storage facilities usually house a wide variety of pesticides. Therefore, unless it is known specifically what is burning, it must be assumed that highly toxic substances are being produced.

Fighting the fire before notification of the fire department is done only if it is certain that the fire can be easily extinguished. Contact the facility supervisor, who then should be present at the fire to confirm which pesticides are present, how much of each, and where they are located. The last inventory may not be accurate as the location and quantity of the pesticides stored often change. Have someone call the appropriate emergency numbers listed in the plan to alert the necessary agencies and staff.

Firefighting tactics. The first action that must be taken upon arrival of fire fighters at the fire site is to decide whether or not to let the facility burn. If this decision was not made during the pre-fire planning, then it is made by the commanding officer of the firefighting unit, based upon contingency plans formed during the pre-fire planning.

The fire should be attacked from upwind to avoid toxic smoke and from a safe distance so that firefighters are clear of the danger of exploding containers. Evacuate personnel located downwind from the fire and keep unauthorized individuals from entering the fire area.

Firefighters should wear personal protective equipment consisting of rubber or neoprene gloves, boots, turnouts, and helmet. Self-contained positive pressure breathing apparatus should be worn whenever fighting a pesticide fire.

Avoid contact with pesticide material, smoke, mist, and water runoff. Be alert and be checked for symptoms of pesticide poisoning during the fire. In case of pesticide contact, leave the site immediately and apply first-aid procedures. Wash face and hands before eating, drinking, smoking, or using the toilet. Do not put fingers in mouth or rub eyes. If turnout clothing becomes soaked through after contact with fallout, leave the fire site immediately, remove contaminated clothing, and shower. Firefighters should be immediately relieved from duty and checked for possible poisoning if exposed to fumes or smoke without adequate protection.

The fire should be confined by cooling adjoining structures to prevent spread of the fire. As little water as possible should be used when fighting a pesticide fire. Water will cool the burning pesticides and may prevent the decomposition of the pesticides into less toxic compounds. However, water runoff must be assumed toxic and can be a serious problem because the water will spread contamination over a wide area. The water runoff control plan should be implemented to contain the contaminated water within as small an area as possible. Steam from water on the fire can result in toxic fallout which could spread contamination far from the site.

A fog spray, which is most effective, should be used for fighting pesticide fires. Straight stream should not be used because it may break bags and bottles which could result in adding fuel to the fire and increasing the amount and area of contamination. Consider using foam when large volumes of flammable solvents are released from ruptured containers.

Firefighters should remove protective clothing upon leaving the fire site. This clothing should be impounded with contaminated equipment awaiting decontamination. They must shower and shampoo thoroughly and change into clean clothing. Inner clothing worn while fighting the fire should be washed in detergent and bleach in a wash load separate from normal washings. Contaminated firefighting protective clothing and equipment should be decontaminated by washing thoroughly with a strong (heavy duty) nonphosphorous detergent. Coveralls, gloves, and boots should be worn when decontaminating equipment. Cotton-jacketed hoses must be pressure tested and discarded if they were weakened by detergent.

Post-fire Cleanup.

The fire scene should be secured to keep out unauthorized personnel until cleanup and decontamination have been completed. Post warning signs and rope off burned-out and water run-off areas. Appropriate federal, state and local organizations (e.g., regional EPA office, the comparable state agency, the state Public Health Office and the Emergency Response Program) should be included when developing the cleanup plan. For example, these agencies must participate in the location of an "approved" site for disposal of pesticide-contaminated waste and debris.

All workers participating in the cleanup operations must be thoroughly briefed on the potential hazards. They must also be aware of first-aid procedures in case of contact with pesticides or contaminated material and symptoms of pesticide poisoning. Personnel working within the fire site during cleanup should wear, as a minimum, personal protective equipment consisting of gloves, boots, coveralls and respirator. A "clean area" should be established to provide a break area for the cleanup crew. This area should have eating and toilet facilities. A place should be included to remove and hang up contaminated protective clothing and to wash up before entering the clean area. When leaving the fire site at the end of the duty day or when work is completed, workers should remove contaminated clothing, shower thoroughly, and change to clean clothing. Contaminated clothing should be washed in strong (heavy duty) nonphosphorous detergent and bleach in a separate wash load.

Materials-handling equipment should be used whenever possible to minimize human contact with contaminated debris. All equipment should be made of metal to expedite decontamination. Porous materials, such as wood, cannot be decontaminated and therefore, if contaminated, must be destroyed. Vehicles used to transport debris must be enclosed and leakproof to prevent the spread of contaminated material along the route to the disposal site. Trucks if used, should have metal beds.

Dikes should be constructed around drains to prevent spilled pesticide or other contaminated material from entering the storm and sanitary sewer systems during cleanup. Pesticide containers must be handled carefully to prevent spillage of the contents as they may have been damaged during the fire. Concentrated pesticides that are

spilled during the post-fire cleanup should be cleaned up. Debris should be lightly sprinkled with water to reduce toxic dust. Use water sparingly as excess will have to be treated as a liquid spill. After the debris has been cleared, the fire site should be decontaminated. Work the decontamination solution that has been recommended by CHEMTREC or a pesticide manufacturer into all surfaces using stiff brooms. Soak up the solution with absorbent material. Sweep up the absorbent material, place it in a plastic bag, and take it to the disposal site. Soil exposed to water runoff should be removed to a depth of at least 3 inches below the moist soil and taken to the disposal site. Soil samples should be taken and analyzed to ensure that all the contaminated soil has been removed before fresh soil is added.

When the cleanup of the fire site is completed, the cleanup equipment must be decontaminated. Discard or destroy contaminated equipment which contains porous material, such as wood handles, fiber or straw brooms, leather shoes, etc., because they cannot be effectively decontaminated. Wash the non-porous equipment with soap and water, then apply the recommended decontamination solution with a brush or mop. All surfaces should be thoroughly rinsed using a sparing amount of water. All wash and rinse water should be collected for disposal.

Table 10. Partial list of pesticides used in public health and structural pest management.

Type	Common Name	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Signal Words
Insect Attractants	octenol			
Botanicals and Pyrethroid Insecticides	allethrin	680-11000	>11,200	Caution
	azadirachtin	>5,000	>2,000	Caution
	bifenthrin	54.5	>2,000	Warning
	bioresmethrin	450-680		Caution
	cyfluthrin	500-800	>5,000	Caution
	cypermethrin	247		Warning
	cyphenothrin	310-419		Warning/Caution
	d-limonene			Warning/Caution
	d-trans allethrin	425-860		Caution
	deltamethrin	129-139	>2,000	Warning
	empenthrin	1,680-2,280		
	esfenvalerate	74-458	>5,000	Warning
	fenfluthrin	85-120	1,535-2,500	
	fenothrin	>10,000	>5,000	Caution
	fenvalerate	451	>2,500	Caution
	fluvalinate	>3,000		Warning
	lambda-cyhalothrin	19-79	1,293-1,507	Warning
	linalool			Caution
	permethrin	2,000->4,000	>4,000	Warning
	phenothrin	>5,000	>2,000	Caution
	pyrethrins, pyrethrum	200-2,600	>1,800	Caution
	resmethrin	1,500-4,240	2,500->3,040	Caution
	rotenone (derris)	60-1,500	>1,000-3,000	Caution
	tetramethrin	>4,640	>15,000	Caution
	tralomethrin	99-3,000	>2,000	Warning/Caution
Carbamate Insecticides	bendiocarb	46-156	566-800	Warning/Caution
	carbaryl	307-986	>500->4,000	Caution
	propoxur	83-104	>1,000->2,400	Warning/Caution
Chlorinated Hydrocarbon Insecticides	dicofol	575-1,331	1,000-1,230	Caution
	methoxychlor			
Insect Growth Regulators	diflubenzuron	4,640->10,000	>4,640	Caution
Chitin Inhibitors	hexaflumuron	>5,000	>5,000	Caution
	iufenuron	>2,000	>2,000	Caution
Juvenoids	hydroprene	>5,100	>5,100	Caution
	methoprene	>34,600	3,038->3,500	Caution
	pyriproxyfen	>5,000	>2,000	Caution
Fumigants (AVT = acute vapor toxicity)	chloropicrin	250		Danger
	methyl bromide	AVT = 200 ppm		Danger
	napthalene	2,200		Caution
	paradichlorobenzene	500-5,000	>2,000	Warning
	phosphine	AVT = 200 ppm		Danger
	sulfuryl fluoride			Danger

Type	Common Name	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Signal Words
Inorganic Insecticides	borax, boric acid	2,660-5,190		Caution
	diatomaceous earth			Caution
	precipitated. silica			Caution
	sodium fluoride	(to humans) 75-150		Danger
Microbial Insecticides	*Bacillus thuringiensis var. israelensis*			Caution
	Bacillus sphaericus			Caution
		13.6		
Insecticidal Bait Toxicants	abamectin	1,131	>2,000	Caution
	hydramethylnon	543	>5,000	Caution
	sulfluramid			Caution
		866-945		
Organophosphate Insecticides	acephate	82-245	>2,000	Caution
	chlorpyrifos	941-3,733	202-2,000	Warning
	chlorpyrifos-methyl	160	>2,000	Warning
	cythioate	300-400	>2,500	Warning
	diazinon	56-80	3,600	Warning/Caution
	dichlorvos, DDVP	28-500	75-107	Danger
	dimethoate	19-176	>150-1,150	Warning
	dioxathion	2-12	53-350	Danger/Warning
	disulfoton	250-740	6-25	Danger
	fenitrothion	255-740	200->3,000	Warning
	fenthion	885-2,800	1,680-2,830	Warning
	malathion	17-24	4,000->4,444	Caution
	methomyl	250-430		Caution
	naled	2,050	800-1,100	Danger
	pirimiphos-methyl	119	>2,000->4,000	Caution
	propetamphos	1,740	2,825	Warning/Caution
	ronnel	1,000-13,000	1,000-2,000	Caution
	temephos	450-630	>4,000	Caution
	trichlorfon		>2,000	Warning
		8,500		
Insect Repellents	R-874	1,950-2,000		Caution
	deet (di-ethyl toluamide)	12,000->20,000	10,000	Caution
	dibutyl pththalate	6,900-8,200		Caution
	dimethyl phthalate	5,230-7,320	>4,000	Warning
	MGK 326	430-4,000	9,400	Caution
	permethrin		>4,000	Warning/Caution
Solvents (as active ingredients)	petroleum distillates			
		6,150->7,500		
Insecticide Synergists	piperonyl butoxide	2,800	>7,950	Caution
	MGK 264		>9,000	Caution
		255-740		
Avicides	fenthion	20	1,680-2,830	Warning
	4-aminopyridine			Caution/Danger

Type	Common Name	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Signal Words
Rodenticides	brodifacourn	0.27	50	Caution
Anticoagulants	bromadiolone	1.13		Caution
	chlorophacinone	20.5		Caution
	difethialone	0.51-0.56		Caution
	diphacinone	1.86-2.88		Caution
	warfarin	1-186		Caution
Nonanticoagulants	bromethalin	2.0-5.9		Caution
	cholecaliferol	40-50		Caution
	strychnine	1-30		Danger
	zinc phosphide	45		Danger/Caution
Other Neurotransmitter	imidicloprid	1,858-2,591	>2,000	Caution
Disruptors	fipronil	100	>2,000	Warning

Sources: *Commercial and Experimental Organic Insecticides* (College Park, Md.: Entomological Society of America, *1985),105; Farm Chemicals Handbook* (Willoughby, Ohio: Meister Publishing, 1996); and *The Pesticide Manual,* 10th ed. (Surrey, England: British Crop Protection Council, 1994).

NOTE: Materials are listed by common chemical name; basic toxicity data (against laboratory animals), and signal words are generally listed on their product labels. [Michigan Extension Service - 1998]

This chapter printed from the
University of Florida and the American Mosquito Control Association
Public Health Pest Control WWW site at http://www.ifas.ufl.edu/~pest/vector/